TEKA Kom. Mot. Energ. Roln. – OL PAN, 2009, 9, 134–137

QUALITY ANALYSIS OF THE WORK OF A BELT CONVEYOR SYSTEM IN SOWING FINE VEGETABLE SEEDS

Józef Kowalczuk, Janusz Zarajczyk

Department of Horticultural Machinery University of Life Sciences in Lublin

Summary. The paper presents laboratory tests results regarding the quality of sowing Joba carrot, Vistula parsley and Polanowska onion seeds distributed with the working section of S011 Alex seeder with a conveyor belt system. The test was conducted for the working speeds ranging from 0.5-0.8 $m \cdot s^{-1}$, every 0.1 $m \cdot s^{-1}$. It was found out that the most advantageous shares of the tested seeds in the examined classes of distances in a row were obtained at the working speed of the seeder of 0.5 $m \cdot s^{-1}$. A increase of the seeder working speed over 0.5 $m \cdot s^{-1}$ in each case caused significant deterioration of the precision of seeds distribution along the row, which found its expression in a lowered share of single seeds and increased shares of duplicated seeds and skips. A statistical analysis of the obtained results in most cases showed significant differences between the shares of single, duplicated and skipped seeds at the tested working speeds of S011 Alex seeder. Hence, it can be concluded that the working speed of the seeder significantly affected the quality of sowing fine vegetable seeds in laboratory conditions.

Key words: precision seeding, fine vegetable seeds, seeding quality, seeder working speed.

INTRODUCTION

Precision seeding compared to drill seeding (row seeding) ensures appropriate spacing of seeds in rows, which helps plants take more advantage of the growing conditions. This method enables plants to grow and develop steadily and the achieved yield is higher [Gaworski 1998, Szulc 2003].

Almost until presently in Poland only garden press or brush drill seeders of section-based construction were used to seed grains [Kowalczuk, Węgrzyn 1995]. These seeders enabled desired quantities of seeds to be dispensed onto the required unit of area, with pre-set row-spacing preserved, but did not ensure regular dosage of seeds in rows or the same depth required for all seeds. To meet the latter requirements, it is recommended to use precision seeders. The Weremczuk company manufactures a belt-conveyor precision seeder S011 Alex designed for precision seeding of various sizes of seeds. In order to use this seeder for sowing fine vegetable grains it is necessary to determine an influence of its particular working speeds on the quality of seeding.

MATERIALS AND METHODS

The goal of the research was to examine an influence of the working speed of S011 Alex seeder on the quality of fine vegetable grains seeding (carrot, onion, parsley). The research was carried out on a special research stand. (Fig.1).

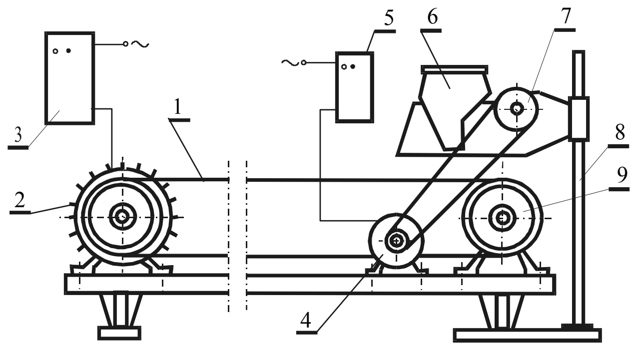

Fig. 1. The scheme of a research stand: 1–belt, 2,4–electric engine, 3,5– frequency converter, 6–seed dispensing section, 7–drive wheel of seed dispensing section, 8–supporter, 9–belt-straining roller

The research stand is composed of belt 1*,* equipped with a line scale, on which the seeds are dropped. The belt is strained between two wheels and propelled by means of an electric engine 2 whose rpm rate is regulated by means of frequency converter *3*. The seed dispensing section is installed right above the belt. The section is propelled by electric engine *4* whose rpm rate is regulated by means of frequency converter *5*. Such an organisation of the propulsion system enables independent and smooth regulation of the speed of the belt on which the seeds are dropped and of the speeds of the belt inside the seed dispensing section of the examined seeder.

The belt that was applied in carrot and onion seeding had holes of 3 mm in diameter while the belt applied in parsley seeding had 2.8 mm holes. The holes in the belts were arranged alternately in two rows, 15 mm away from each other. The belts were selected with respect to the sizes of the sown seeds (Tab. 1), which were determined on the basis of a sample of 100 specimens picked up at random.

Table 1. Main features of the sown seeds

Feature	Meas. unit	Joba Variety Carrot	Vistula Variety Parsley	Polanowska Variety Onion
Length	mm	2.6	2.0	2.8
Width	mm	1.3	1.1	2.3
Thickness	mm	0.8	0.6	0.9

The research was carried out at the belt's speed (working speed of the seeder) ranging from 0.5 to 0.8 $m \cdot s^{-1}$, every 0.1 $m \cdot s^{-1}$. Seeds disposed by the working section of the seeder fell on the belt covered on its measurement part with a colourless smear and got stuck to it. Then distances between the seeds were measured on 1 m long measurement sections, in five repetitions. The next step was calculation of the percentage shares of single plants, duplicated plants and skips carried out by means of the research methodology designed for seeder precision defined in ISO 7256/1.

Plants were considered as single if the distance between them was bigger than half of the average real distance and smaller or equal to 1.5 of the real distance. They were considered as duplicate if they fell at distances smaller or equal to half of the average real distance. Distances longer than 1.5 of the average real distance were considered as skips.

The following were then calculated:

- the percentage of single plants expressed as a quotient of the number of single seeds and overall number of seeds dropped on all measurement sections,
- percentage of duplicated plants expressed as a quotient of the number of duplicated seeds and overall number of seeds dropped on all measurement sections,
- percentage of skips expressed as a quotient of the number of skips and overall number of seeds dropped on all measurement sections.

The obtained research results were made subject to further statistical analysis based upon a variance analysis and multiple confidence intervals of T-Tukey at an assumed level of $\alpha = 0.05$.

RESEARCH RESULTS AND THEIR ANALYSIS

Table 2 presents the results of the research showing the influence of S011 Alex seeder' working speed on the precision of seeds distribution along the row and their statistical analysis.

Table. 2. Influence of S011 Alex working speeds on the shares of single, duplicated and skipped seeds of the examined vegetables

Specification	Seeder working speed ($m \cdot s^{-1}$)	Single seeds (%)	Duplicated seeds (%)	Skips (%)
Joba variety carrot	0.5	60.5^{a}*	24.5^{a}	15.0^{a}
	0.6	55.4^{b}	29.9^{bcd}	14.7^{a}
	0.7	51.8^{c}	27.9^{b}	20.3^{b}
	0.8	50.2^{c}	29.7^{bc}	20.1^{b}
Vistula variety parsley	0.5	58.5^{a}	21.6^{a}	19.9^{ab}
	0.6	53.3^{b}	28.1^{d}	18.6^{a}
	0.7	51.3^{bc}	26.4^{e}	22.3^{bc}
	0.8	55.7^{c}	28.8^{f}	15.5^{c}
Polanowska variety onion	0.5	60.4^{a}	19.8^{a}	19.8^{a}
	0.6	53.6^{b}	22.2^{a}	24.2^{b}
	0.7	52.4^{b}	31.4^{b}	16.2^{c}
	0.8	50.0^{c}	30.0^{b}	20.0^{d}

* Letters used as upper indexes indicate that for the tested working speeds significant differences occurred between the shares of single, duplicated and skipped seeds at the level α=0,05.

The data presented in Table 2 shows that the best shares of carrot, parsley and onion seeds in the examined distance classes in rows were achieved at the seeder working speed of 0.5 m/s. At this speed the share of single seeds for Joba carrot was 60.5%, duplicated seeds 24.5% and skips 15.0%. For Vistula parsley the obtained results were 58.5% of single seeds, 21.6 of duplicated seeds and 19.9 of skips. The corresponding values for Polanowska onion were 60.4%, 19.8% and 19.8%, respectively. An increase of the seeder working speed over 0,5 $m \cdot s^{-1}$ in each case caused deterioration of the precision of seeds distribution along the row.

Statistical analysis of the obtained results in most cases showed significant differences between the shares of single, duplicated and skipped seeds at the tested working speeds of S011 Alex seeder. Hence, it can be concluded that within the examined range the working speed of the seeder significantly affected the quality of sowing the seeds of carrot, parsley and onion in laboratory conditions.

CONCLUSIONS

1. Ther was identified a significant influence of the working speed of S011 Alex seeder on the percentage shares of single, duplicated and skipped seeds in the examined classes of distances between seeds in a row for Joba carrot, Vistula parsley and Polanowska onion.
2. The most advantageous share of carrot, parsley and onion seeds in the examined classes of distances in a row was obtained for the seeder working speed of 0.5 $m \cdot s^{-1}$.
3. An increase of the seeder working speed over 0,5 $m \cdot s^{-1}$ in each case caused a significant deterioration of the precision of seeds distribution along the row.

REFERENCES

Gaworsk M., 1998: Vegetable seeders – precision and modernity. Fruit, vegetables, flowers, 17-18, 27.

Kowalczuk J., Węgrzyn A., 1995: Assessment of usefulness of a belt seeder for planting beans. Materials generated at Polish Scientific Conference “Science in horticultural practice”. Wyd. AR, Lublin.

Szulc T., 2003: Seeders – Main progress directions. Technika Rolnicza, 2, pp. 22-27.

International standard ISO 7256/1-1884 (E), 1984: Sowing equipment – test methods. Part 1: Single seed drills.

ANALIZA JAKOŚCI PRACY TAŚMOWEGO ZESPOŁU WYSIEWAJĄCEGO PRZY SIEWIE DROBNYCH NASION WARZYW

Streszczenie. Przedstawiono wyniki badań laboratoryjnych jakości siewu nasion marchwi odmiany Joba, pietruszki odmiany Vistula i cebuli odmiany Polanowska sekcją roboczą siewnika S011 Alex z taśmowym zespołem wysiewającym. Przeprowadzono je przy prędkości roboczej siewnika w zakresie 0,5-0,8 $m \cdot s^{-1}$, co 0,1 $m \cdot s^{-1}$. Badania wykazały, że najkorzystniejsze udziały nasion wymienionych warzyw w badanych klasach odległości w rzędzie wystąpiły przy prędkości roboczej siewnika 0,5 $m \cdot s^{-1}$. Wzrost prędkości roboczej siewnika powyżej 0,5 $m \cdot s^{-1}$ wpłynął na pogorszenie dokładności rozmieszczenia nasion w rzędzie, co wyrażało się obniżeniem udziału wysiewów pojedynczych oraz wzrostem udziału wysiewów podwójnych i przepustów. Analiza statystyczna wyników wykazała w większości przypadków istotne różnice między udziałami wysiewów pojedynczych, podwójnych i przepustów przy badanych prędkościach roboczych siewnika. Na tej podstawie można stwierdzić, że prędkość robocza siewnika wpływała istotnie na jakość siewu nasion badanych odmian warzyw w warunkach laboratoryjnych.

Słowa kluczowe: siew precyzyjny, drobne nasiona warzyw, jakość siewu, prędkość robocza siewnika.